

1 **STATOR OF A BRUSHLESS DIRECT CURRENT MOTOR AND A**
2 **METHOD FOR MAKING IT**

3 **Background of the Invention**

4 **1. Field of the Invention**

5 The present invention relates to a stator of a brushless direct current
6 motor and a method for making it, wherein the stator of the brushless direct
7 current motor may be processed and manufactured conveniently.

8 **2. Description of the Related Art**

9 A conventional stator combination structure of a miniature heat-sink
10 fan in accordance with the prior art shown in Fig. 1 comprises a stator coil 90,
11 upper and lower pole plates 91 and 92, a circuit board 93, and a housing 94. A
12 metallic shaft tube 95 having a proper outer diameter passes through central
13 holes of the stator coil 90, the upper and lower pole plates 91 and 92, and the
14 circuit board 93, so that they are combined integrally. Then, the bottom of the
15 metallic shaft tube 95 is pressed in the central column hole 96 of the housing
16 94. The outer diameter of the metallic shaft tube 95 is provided with multiple
17 sections, and has a top end formed with an annular lip 951, a mediate portion
18 formed with an enlarged diameter portion 952, and a bottom 953. The stator coil
19 90 is provided with a central hole having a diameter slightly greater than the
20 outer diameter of the enlarged diameter portion 952 of the metallic shaft tube
21 95. The upper pole plate 91 is provided with a central hole having a diameter
22 slightly smaller than the outer diameter of the annular lip 951 of the metallic
23 shaft tube 95. The lower pole plate 92 is provided with a central hole having a
24 diameter slightly smaller than the outer diameter of the bottom 953 of the
25 metallic shaft tube 95. The circuit board 93 is provided with a central hole
26 having a diameter slightly smaller than the outer diameter of the bottom 953 of

1 the metallic shaft tube 95. The upper pole plate 91 is pressed on the annular lip
2 951 of the metallic shaft tube 95 in a forcibly press manner. Then, the stator coil
3 90 is mounted on the enlarged diameter portion 952 of the metallic shaft tube
4 95 through the bottom 953 of the metallic shaft tube 95. Then, the lower pole
5 plate 92 and the circuit board 93 are pressed on the bottom 953 of the metallic
6 shaft tube 95, so that the stator coil 90 is clamped by the upper and lower pole
7 plates 91 and 92 to be fixed on the enlarged diameter portion 952 of the metallic
8 shaft tube 95 by the diameter difference of the outer diameter of the metallic
9 shaft tube 95. The outer diameter of the bottom 953 of the metallic shaft tube
10 95 is slightly greater than the inner diameter of the central column hole 96 of
11 the housing 94.

12 In such a stator of the conventional brushless direct current motor, the
13 metallic shaft tube 95 needs to be formed with three sections of different
14 diameters, and the upper and lower pole plates 91 and 92 and the circuit board
15 93 need to be respectively formed with an inner hole whose inner diameter
16 forms a proper tolerance with the outer diameter of the metallic shaft tube 95.
17 Thus, fabrication of the stator is more inconvenience. In addition, the upper and
18 lower pole plates 91 and 92 each only have a smaller thickness. Thus, the
19 sensing area of the upper and lower pole plates 91 and 92 and the rotor is
20 reduced relatively. Thus, the stator cannot enhance the rotational torque of the
21 rotor.

22 The stator structure of another conventional brushless direct current
23 motor in accordance with the prior art shown in Fig. 2 comprises a stator 80
24 wound with a coil 803. The upper and lower ends of the stator 80 are provided
25 with columns 801 and 802 for combining and positioning the upper and lower
26 pole plates 81 and 82 and the circuit board 83. A metallic shaft tube 84 whose

1 outer diameter is greater than the diameter of the central holes respectively
2 provided by the stator 80, the upper and lower pole plates 81 and 82 and the
3 circuit board 83, may be pressed into the central holes in a forcibly press
4 manner. The metallic shaft tube 84 has a protruding annular lip 841 to prevent
5 detachment, and the rotation shaft 851 of the rotor 85 may be pivoted on the
6 metallic shaft tube 84 to rotate. In such a stator of the conventional brushless
7 direct current motor, the fabrication also uses the difference of the larger and
8 the smaller diameters to combine in a forcibly press manner, and also needs
9 combination of the columns 801 and 802 provided by the upper and lower ends
10 of the stator 80 with the upper and lower pole plates 81 and 82 and the circuit
11 board 83. Thus, the fabrication of the stator is more inconvenience. In addition,
12 the upper and lower pole plates 81 and 82 each only have a smaller thickness.
13 Thus, the sensing area of the upper and lower pole plates 81 and 82 and the
14 annular permanent magnet 852 of the rotor 85 is small. Thus, the stator cannot
15 enhance the rotational torque of the rotor.

16 **Summary of the Invention**

17 The primary objective of the present invention is to provide a method
18 for making a stator of a brushless direct current motor, wherein the stator may
19 be processed and manufactured conveniently.

20 A secondary objective of the present invention is to provide a stator
21 of a brushless direct current motor, wherein the upper and lower pole plates of
22 the stator and the annular permanent magnet of the rotor may have a larger
23 sensing area, and have a larger magnetically conducting passage. Thus, the
24 stator may enhance the rotational torque of the rotor.

25 In accordance with the present invention, there is provided a method
26 for making a stator of a brushless direct current motor, includes the steps of:

1 winding a coil set to predetermined turns, thereby forming a ring body having
2 a central hole, and performing an insulation process; mounting at least two pole
3 plates on two end faces of the coil set respectively, the pole face and the
4 magnetically conducting plates of each pole plate encompassing the inner and
5 outer periphery of the coil set respectively, and a wiring head of the coil set
6 being drawn outside of the pole plate; and mounting a combination member on
7 the magnetically conducting rings (or plates) of each pole plate, thereby
8 forming a stator. The pole faces of each pole plate may be induced with the
9 permanent magnet of the rotor.

10 Further benefits and advantages of the present invention will become
11 apparent after a careful reading of the detailed description with appropriate
12 reference to the accompanying drawings.

13 **Brief Description of the Drawings**

14 Fig. 1 is an exploded perspective view of a conventional stator
15 structure in accordance with the prior art;

16 Fig. 2 is an exploded perspective view of a conventional stator
17 structure in accordance with the prior art;

18 Fig. 3 is an exploded perspective view of a stator of a
19 brushless direct current motor in accordance with a first embodiment of the
20 present invention;

21 Fig. 4 is a cross-sectional assembly view of the stator
22 of a brushless direct current motor as shown in Fig. 3;

23 Fig. 5 is an exploded perspective view of a stator of a brushless direct
24 current motor in accordance with a second embodiment of the present
25 invention;

1 Fig. 6 is a cross-sectional assembly view of the stator of a brushless
2 direct current motor as shown in Fig. 5; and

3 Fig. 7 is an exploded perspective view of a stator of a brushless direct
4 current motor in accordance with a third embodiment of the present invention.

5 **Detailed Description of the Preferred Embodiments**

6 Referring to the drawings and initially to Fig. 3, a stator structure of
7 a brushless direct current motor in accordance with a first embodiment of the
8 present invention primarily comprises a coil set 1, at least two pole plates 2, and
9 a combination member 3.

10 The coil set 1 may be a conventional metallic wire that is wound and
11 processed on a winding machine, thereby forming a ring body having a central
12 hole 12. The coil set 1 may be preferably formed or coated with an insulating
13 layer in an impregnated and plated manner. In addition, the coil set 1 has a
14 wiring head 11 for connecting the electric power.

15 The at least two pole plates 2 are made of magnetically conducting
16 material, and may be combined on the two end faces of the coil set 1. Each pole
17 plate 2 has pole faces 21 and magnetically conducting rings 22. In the preferred
18 embodiment, each pole face 21 is located adjacent to the circumference of the
19 smaller diameter of the center of the pole plate 2. The pole faces 21 of the upper
20 and lower pole plates 2 are arranged in a staggered manner, so as to form a
21 central hole 23. The sensing magnet of a rotor may be placed into the central
22 hole 23, to induce with the pole face 21 to rotate. The magnetically conducting
23 rings 22 are arranged on the outer circumference of the pole plate 2.

24 The combination member 3 may preferably be made of magnetically
25 conducting material, and may be closely combined with the magnetically
26 conducting rings 22 of the upper and lower pole plates 2, so that the pole plate

1 2 may be fixed. In addition, the combination member 3 may also strengthen the
2 magnetically conducting effect.

3 The stator of the present preferred embodiment may be made by the
4 following steps:

5 (1) The coil set 1 is wound to predetermined turns, thereby forming
6 a ring body having a central hole 12, and may be performed by an insulation
7 process;

8 (2) The two pole plates 2 are respectively mounted on the two end
9 faces of the coil set 1, the pole face 21 of each pole plate 2 is mounted in the
10 central hole 12 of the coil set 1, the magnetically conducting rings 22 of each
11 pole plate 2 encompass the outer circumference of the coil set 1, and the wiring
12 head 11 of the coil set 1 is drawn outside of the pole plate 2;

13 (3) The combination member 3 is mounted on the outside of each pole
14 plate 2, and is closely combined with the magnetically conducting rings 22 of
15 each pole plate 2, thereby forming a stator as shown in Fig. 4.

16 Referring to Fig. 5, a stator structure of a brushless direct current
17 motor in accordance with a second embodiment of the present invention
18 primarily comprises a coil set 1, two pole plates 4, and a combination member
19 5.

20 The coil set 1 is the same as that of the first embodiment, and may be
21 wound, impregnated and plated, or coated with an insulating layer. In addition,
22 the coil set 1 has a wiring head 11 for connecting the electric power. The coil
23 set 1 may form a ring body having a central hole 12.

24 The at least two pole plates 4 are made of magnetically conducting
25 material, and may be combined on the two end faces of the coil set 1. Each pole
26 plate 4 has pole faces 41 and a magnetically conducting plate 42. The pole faces

1 41 are located on the circumference of the larger diameter of the pole plate 4,
2 and may be induced with the annular permanent magnet provided by the rotor.
3 The magnetically conducting plate 42 is located adjacent to the circumference
4 of the smaller diameter of the center of the pole plate 4. The magnetically
5 conducting plate 42 may form a central hole 43 which allow the combination
6 member 5 to form a close fit by the difference of larger and smaller diameters.
7 In the preferred embodiment, the pole faces 41 at the two sides of the coil set
8 1 are arranged in a staggered manner.

9 The combination member 5 is made of magnetically conducting
10 material, and may be closely combined with the magnetically conducting plate
11 42 of the upper and lower pole plates 4, so that the pole plate 4 may be fixed.
12 In addition, the combination member 5 may also strengthen the magnetically
13 conducting effect.

14 The stator of the present preferred embodiment may be made by the
15 following steps:

16 (1) The coil set 1 is wound to predetermined turns, thereby forming
17 a ring body having a central hole 12, and may be performed by an insulation
18 process;

19 (2) The at least two pole plates 4 are respectively mounted on the two
20 end faces of the coil set 1, the pole faces 41 of each pole plate 4 encompass the
21 periphery of the coil set 1 in a staggered manner, the magnetically conducting
22 plate 42 of each pole plate 4 is mounted in the central hole 12 of the coil set 1,
23 and the wiring head 11 of the coil set 1 is drawn outside of the pole plate 4;

24 (3) The combination member 5 is mounted in the magnetically
25 conducting plate 42 of each pole plate 4 in a close fit manner, thereby forming
26 a stator as shown in Fig. 6.

1 Referring to Fig. 7, a stator structure of a brushless direct current
2 motor in accordance with a third embodiment of the present invention primarily
3 comprises a coil set 6, four pole plates 7, and a combination member 5.

4 The coil set 6 may be wound around an insulating layer 63. In
5 addition, the coil set 6 has a wiring head 61 for connecting the electric power.
6 The insulating layer 63 has a central hole 62.

7 The pole plates 7 are made of magnetically conducting material, and
8 are respectively mounted on the two end faces of the coil set 6. Each pole plate
9 7 has multiple pole faces 71 and multiple magnetically conducting plates 72.
10 Each pole face 71 is located on the circumference of the larger diameter of the
11 pole plate 7, and may be induced with the annular permanent magnet provided
12 by the rotor. Each magnetically conducting plate 72 is located in the inner wall
13 of the central hole 62 of the insulating layer 63. The magnetically conducting
14 plates 72 may form a central hole 73 which allow the combination member 5
15 to form a close fit by the difference of larger and smaller diameters. In the
16 preferred embodiment, the two end faces of the coil set 6 are respectively fitted
17 with two pole plates 7. The pole faces 71 of the two pole plates 7 at the same
18 side may be adjacent to each other or overlap each other. The magnetically
19 conducting plates 72 of the two pole plates 7 at the same side may be adjacent
20 to each other or overlap each other. The pole faces 71 of the two pole plates 7
21 at the other side of the coil set 6 are arranged in a staggered manner.

22 The combination member 5 is made of magnetically conducting
23 material, and may be closely combined with the magnetically conducting plate
24 72 of the upper and lower pole plates 7, so that the pole plate 7 may be fixed.
25 In addition, the combination member 5 may also strengthen the magnetically
26 conducting effect.

1 The stator of the present preferred embodiment may be made by the
2 following steps:

3 (1) The coil set 6 is wound around the insulating layer 63 to
4 predetermined turns, and the insulating layer 63 has a central hole 62;

5 (2) The magnetically conducting plates 72 of each pole plate 7 are
6 respectively mounted in the central hole 62 of the insulating layer 63, the pole
7 faces 71 of each pole plate 7 encompass the outer periphery of the coil set 6, the
8 wiring head 61 of the coil set 6 is drawn outside of the pole plate 7, and when
9 at least two pole plates 7 are mounted on the two sides of the coil set 6, the pole
10 faces 71 and the magnetically conducting plates 72 of each the two pole plates
11 7 at the same side may be adjacent to each other or overlap each other; and the
12 pole faces 71 and the magnetically conducting plates 72 of each the two pole
13 plates 7 at two different sides may be arranged in a staggered manner;

14 (3) The combination member 5 is mounted in the magnetically
15 conducting plate 72 of each pole plate 7 in a close fit manner, thereby forming
16 a stator.

17 The stator of the present embodiment has larger pole faces 71 and
18 magnetically conducting plates 72 to combine with the combination member 5,
19 thereby forming a larger magnetically conducting passage. Thus, the stator has
20 a larger magnetic flux, and may provide a larger rotational torque to the rotor.

21 Accordingly, the stator structure of a brushless direct current motor
22 in accordance with the present invention has a simple construction, and the pole
23 face of the stator has a larger sensing area. After the combination member of the
24 stator is combined with the magnetically conducting ring (or plate) of the pole
25 plate, a larger thickness may be formed. Thus, the magnetic flux may be

1 increased. Therefore, the stator may provide a larger rotational torque to the
2 rotor.

3 In addition, in the manufacturing method of the stator structure of a
4 brushless direct current motor in accordance with the present invention, the
5 stator has a simple construction. Thus, the manufacturing method of the stator
6 structure of a brushless direct current motor in accordance with the present
7 invention is more easy, thereby accelerating the manufacturing velocity and
8 productivity of the stator product, so that the cost of fabrication of the stator
9 may be reduced greatly.

10 Although the invention has been explained in relation to its preferred
11 embodiment as mentioned above, it is to be understood that many other possible
12 modifications and variations can be made without departing from the scope of
13 the present invention. It is, therefore, contemplated that the appended claim or
14 claims will cover such modifications and variations that fall within the true
15 scope of the invention.

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